

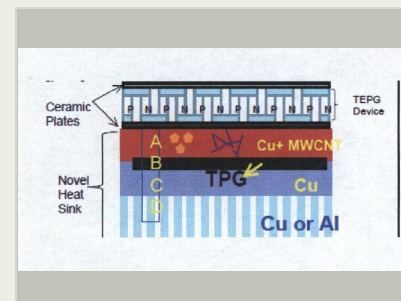
# Alternative Green Technology for Power Generation Using Waste-Heat Energy And Advanced Thermoelectric Materials, Phase II

Completed Technology Project (2012 - 2015)



## Project Introduction

NASA is interested in advancing green technology research for achieving sustainable and environmentally friendly energy sources. Thermo-electric power generation (TEPG) has exceptionally rich potential to fulfill this need. A TEPG module requires (1) material that can provide high figure of merit while still providing efficient heat control; (2) low resistance ohmic contacts that operate at high temperature; and (3) efficient heat sink material to provide optimal temperature difference between hot and cold junctions. In Phase I, we addressed all of these issues. We successfully produced device quality n-type and p-type, single crystalline and bulk nano-composite PbTe material suitable for TEPG device fabrication. We also developed a novel electrical contact technology having low electrical resistance and capability to withstand significantly elevated temperatures (>800 degree C). And we developed a light weight, highly thermal conductive (50 to 60 % better than copper) heat sink material with tailored low coefficient of thermal expansion (CTE). These improvements allowed us to develop the design and technique for fabrication of large scale TEPG on a manufacturing level. In Phase II we will expand upon these developments and implement them. We will fabricate TEPG devices using the nano-composite materials. These devices will utilize the ohmic contacts and the heat sink technology that we developed. We will also utilize another approach that we developed in which two materials (PbTe and (Bi-Sb)<sub>2</sub>(Se-Te)<sub>3</sub> based alloys) are segmented into a two-part material that has high efficiency over the entire temperature range from 200-500 degreeC, PbTe being at the hot end and the (Bi-Sb)<sub>2</sub>(Se-Te)<sub>3</sub> based material at the cold end. Our ultimate goal will be to build a TEPG module using such segmented devices to demonstrate the generation of 1kWatt of power. We will develop the technology of fabricating these modules at a large scale manufacturing level, at low cost.



Alternative Green Technology for Power Generation Using Waste-Heat Energy And Advanced Thermoelectric Materials Project Image

## Table of Contents

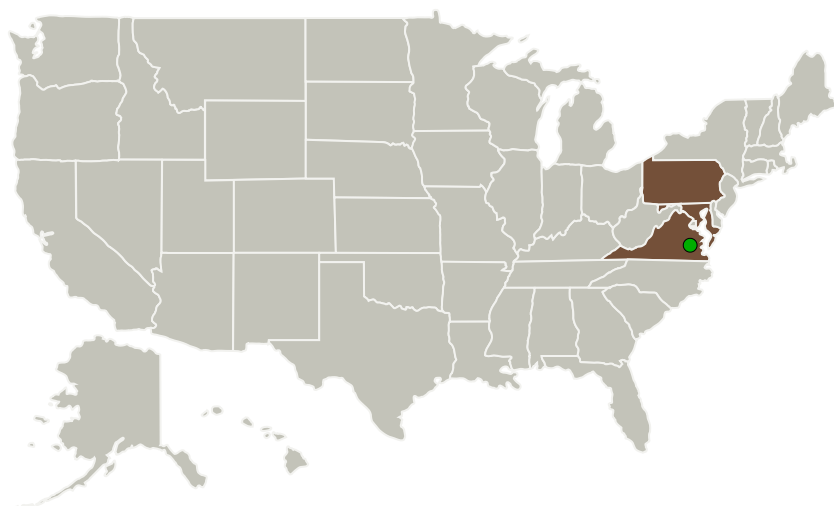
Project Introduction	1
Primary U.S. Work Locations and Key Partners	2
Project Transitions	2
Organizational Responsibility	2
Project Management	2
Images	3
Technology Maturity (TRL)	3
Technology Areas	3
Target Destinations	3

## Alternative Green Technology for Power Generation Using Waste-Heat Energy And Advanced Thermoelectric Materials, Phase II

Completed Technology Project (2012 - 2015)



## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Brimrose Technology Corporation(BTC)	Lead Organization	Industry	Sparks, Maryland
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Maryland	Pennsylvania
Virginia	

## Project Transitions

**June 2012:** Project Start**June 2015:** Closed out

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

Brimrose Technology Corporation (BTC)

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

Carlos Torrez

**Principal Investigator:**

Sudhir B Trivedi

**Co-Investigator:**

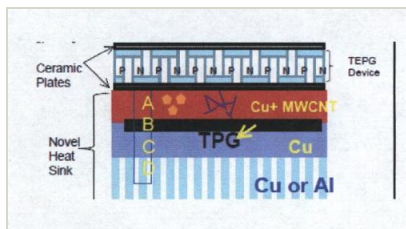
Sudhir Trivedi

# Alternative Green Technology for Power Generation Using Waste-Heat Energy And Advanced Thermoelectric Materials, Phase II

Completed Technology Project (2012 - 2015)



## Images



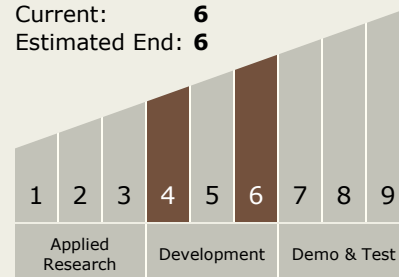
### Project Image

Alternative Green Technology for Power Generation Using Waste-Heat Energy And Advanced Thermoelectric Materials Project Image

(<https://techport.nasa.gov/image/129326>)

## Technology Maturity (TRL)

Start: **4**  
Current: **6**  
Estimated End: **6**



## Technology Areas

### Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - └ TX12.1 Materials
    - └ TX12.1.6 Materials for Electrical Power Generation, Energy Storage, Power Distribution and Electrical Machines

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System